Helicopter Emergency Medical Service – the past and the present

(Lotnicze zespoły ratownictwa medycznego (HEMS) – wczoraj i dziś)

P Osiński[1,A,B,C,D], M Madziała[1,D], Z Kopański[1,2,F], G Sianos [3, E]

Abstract – For many years has Helicopter Emergency Medical Service had a well-established position in medical rescue systems. At the moment rescue helicopters are a link in the chain of pre-hospital medical emergency. As this method of transportation developed, a need for trauma centres, hospital landing zones and a close cooperation with other services (ambulance dispatch, firemen) arose. As a result, helicopters could be used more effectively and more adequately to the current needs for medical emergency service. In Poland, the first air ambulance started functioning in 2000 – it was SP ZOZ Lotnicze Pogotowie Ratunkowe (the Polish Medical Air Rescue). The dynamic development of air emergency was the authors' inspiration to present the history as well as present tasks of Helicopter Emergency Medical Service.

Key words - Helicopter Emergency Medical Service, history, present tasks.

Streszczenie – Na całym świecie od wielu lat lotnicze zespoły ratownictwa medycznego (HEMS) mają ugruntowaną pozycje w systemach ratownictwa medycznego. W chwili obecnej śmigłowce ratownicze są jednym z ogniw łańcucha pomocy przedszpitalnej. Ich rozwój wiązał się jednocześnie z potrzebą tworzenia centrów urazowych, lądowisk przyszpitalnych oraz potrzebą ścisłej współpracy z innymi służbami (dyspozytornie pogotowia ratunkowego, straż pożarna). W efekcie pozwoliło to na najbardziej efektywne i adekwatne wykorzystanie śmigłowca do zaistniałego zapotrzebowania na medyczne czynności ratunkowe.

W Polsce, początek organizowania lotniczych zespołów ratownictwa medycznego datuje się na 2000 rok, kiedy to powołano do życia SP ZOZ Lotnicze Pogotowie Ratunkowe. Dynamiczny rozwój lotniczego pogotowia ratunkowego skłonił autorów do przedstawienia historii i współczesnych zadań lotniczych zespołów ratownictwa medycznego.

Słowa kluczowe - lotnicze zespoły ratownictwa medycznego (HEMS), historia, współczesne zadania.

Author Affiliations:

1. Collegium Masoviense - College of Health Sciences, Żyrardów
2. Faculty of Health Sciences, Collegium Medicum, Jagiellonian University
3. Glasgow Royal Infirmary Trauma and Orthopaedic Department Glasgow

Authors' contributions to the article:

A. The idea and the planning of the study
B. Gathering and listing data
C. The data analysis and interpretation
D. Writing the article
E. Critical review of the article
F. Final approval of the article

Correspondence to:

Prof. dr Zbigniew Kopański, Collegium Masoviense - College of Health Sciences, Żyrardów, G. Narutowicza 35 Str., PL-96-300 Żyrardów, Poland, e-mail: zkopanski@o2.pl

I. THE SHORT HISTORY OF AIR EMERGENCY SERVICE

Evacuating the wounded by helicopters was a common practice as early as during the Second World War. It had, however, certain limitations, as then it was applied only to transporting the wounded from frontline hospitals to hospitals in less dangerous zones so that the treatment could be carried on. Getting the wounded out of the battlefield still involved only traditional vehicle ambulances. It was only towards the end of the War that the emergence of a new air vehicle – a helicopter – made air evacuation out of a battlefield possible.

Its properties allowed the machine to land on an inaccessible ground and to remain suspended over it. Helicopter was used to evacuate the wounded for the first time in April 1944 in Burma, where four soldiers were taken from behind enemy lines [1]. In November 1945 in Fairfield, an army helicopter was used to save 2 people from a sinking boat. That was the first time a helicopter was used for a civilian emergency [2].

Choppers were helpful in transporting the wounded on a bigger scale during the Korean War (1950-1953). Due to curvy and bumpy roads, the duration of the transportation of wounded men was unusually long, which is why they chances for survival were insignificant. It was then that the advantages of a helicopter were fully acknowledged. Choppers can fly in difficult areas and move at high speed, both of which contribute to shorter time and more convenient conditions of getting the wounded to a hospital. A helicopter emergency squad was officially first established on January 1, 1951 as the Second Helicopter Detachment was assigned to 8055th Mobile Army Surgical Hospital (MASH). Approximately 17 500 wounded American soldiers were transported to Mobile Army Surgical Hospitals which were located away from battlefields. There they could be subjected to medical treatment and – if necessary – a surgery [3,4].

In the Vietnam War which followed, emergency flights became quite common. Between 1965 and 1969, helicopters evacuated over 370 000 wounded soldiers, whereas taking into account the whole War the number rises to 900 000 [5]. The shorter time of the transportation (and shorter waiting for surgical attention) as well as the possibility of securing the respiratory tract and stopping haemorrhages by the army medics contributed to the reduction of the mortality rate of wounded American soldiers.

The National Academy of Science had crucial influence on the development of HEMS as in 1966 it issued a publication called "Accidental Death and Disability: The Neglected Disease of Modern Society". The main focus of the article was mortality and disability caused by traumas suffered predominantly in traffic accidents as well as the lack of a coordinated medical rescue system in the USA. At the same time in Baltimore, R. Adams Cowley, a surgeon, created a Shock Trauma Center [6]. He believed that transporting a patient timely to a trauma centre may save his or her life, as it was in the case of badly injured soldiers. Those who could receive surgical attention within the first hour after the accident had much better odds for survival. The surgeon kept popularizing his beliefs and on March 19, 1970 he helped extend the service of the Maryland State Police Aviation Command by medical evacuation flights. That was the first non-military application of a helicopter in Emergency Medical Service [7]. In 1972 at St. Anthony Hospital in Denver, the first civilian chopper in the USA was made available to EMS. IN 1980 there were 39 helicopters in the USA, by 1990 the number had grown to 231, and by 2005 as many as 753 choppers were available for the purposes of medical transport [8].

The first medical emergency helicopter in Germany commenced its service on November 1, 1970 in Munich; its name was "Christoph 1". Since that time, HEMS throughout the country has developed rapidly. Currently, there are over 80 helicopters at the disposal of the German HEMS [9,10].
The first medial rescue helicopter in Austria, "Christophorus 1", began its service in 1983 [11].

In the UK, the first medical helicopter was commissioned in Cornwall in 1987. A London chopper was first used in 1989; initially it was stationed at the Biggin Hill Airport in London. In 1990 the helicopter station was moved to a base of Royal London Hospital, where the helicopters could go up from the rooftop helipad [12].

II. HELICOPTER EMERGENCY MEDICAL SERVICE IN POLAND

In Poland, the Medical Air Rescue was established in 1999, as motioned by Franciszka Cegielska, the Minister of Health at that time. The purpose of establishing the new structure was the creation of a Helicopter Emergency Medical Service (HEMS). In order to do so, the existing Medical Air Squads were conjoined and 15 bases for helicopters were appropriated. What is more, the extent of service was broadened, as helicopters flew also in cases of accidents and sudden illnesses. In that manner, medical transportation squads were transformed into medical rescue teams, the process which ended on January 16, 2001 [13].

The Polish Medical Air Rescue is the only subject in Poland which has HEMS teams at its disposal and is able to dispatch flights directly to the place of accident in order to provide medical attention in health emergencies. In accordance with the regulations of the September 8, 2006 Bill of the Public Medical Rescue, HEMS teams constitute the units of the Public Medical Rescue. Their flights cover the locations within the radius of 100 kilometres away from each helicopter site. Alongside medical rescue flights, the objective of medical rescue helicopters is also to provide transportation service between hospitals. These flight also have the nature of medical rescue service.

The helicopters of the Polish Medical Air Rescue can fly all year-round but only in the daytime and when ground is visible. For these reasons the on-duty periods are variable in relation to the season and weather conditions.

At present, the helicopters of the Polish Medical Air Rescue are stationed in the following permanent bases (Figure 1):

- Białystok - the Białystok-Krywlany Airport - lifeguard 1
- Bydgoszcz - the Bydgoszcz-Biedaszkowo Airport - Lifeguard 2
- Gdańsk - the Gdańsk-Rębiechowo Airport - Lifeguard 3
- Gliwice - the Gliwice-Trynek Airport - Lifeguard 4
- Kielce - the Kielce-Masłów Airport - Lifeguard 5
- Kraków - the Kraków-Balice Airport - Lifeguard 6
- Lublin - the Lublin-Radawiec Airport - Lifeguard 7
- Łódź - the Łódź-Lublinek Airport - Lifeguard 16
- Olsztyn - the Olsztyn-Dajtki Airport - Lifeguard 8
- Płock - the Płock Airport - Lifeguard 18
- Poznań - the Poznań-Ławica Airport - Lifeguard 9
- Sanok - the Sanok Airport - Lifeguard 10
- Suwałki - the Suwałki Airport - Lifeguard 17
- Szczecin - the Szczecin-Goleniów Airport - Lifeguard 11
- Warsaw - the Warszawa-Babice Airport - Lifeguard 12
- Wrocław - the Wrocław-Strachowice Airport - Lifeguard 13
- Zielona Góra - the Zielona Góra-Przylep Airport - Lifeguard 15

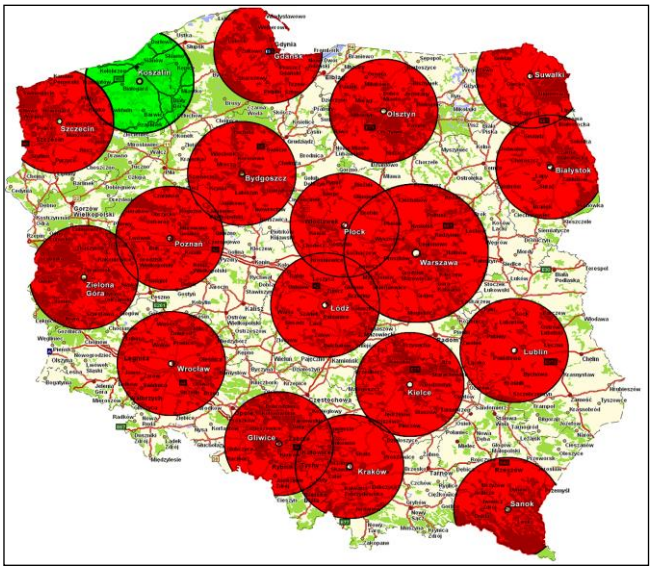

Figure1. The bases of the Polish Medical Air Rescue

*The base in Koszalin is a seasonal base active in the summer of there is an operational helicopter at the disposal of the Polish Medical Air Rescue.

*The circles on the map signify the radius of the area that can be reached during a 20-minute flight. I the case of Warsaw, where an A 109 Power helicopter is used, the 20-minute radius is wider (on November 20, 2009 the A 109 Power helicopter was destroyed in an accident).

The persons authorized to call in and send HEMS teams are:

- Emergency Communication Centre dispatchers,
- Emergency service dispatchers,
- The general dispatcher of the Polish Medical Air Rescue,
- The dispatchers of other rescue units (Fire Brigades, Mountain Rescue Services, Water Rescue Services, Ship Rescue Services, the Rescue Service of the Mazuria Lake District) via an emergency service medical dispatcher or directly on the basis of agreements signed,
- Coordinating doctors of medical rescue.

The Polish Medical Air Rescue has defined situations in which a HEMS team should be sent. The following cases are listed:

- The estimated air transportation time of a patient in an emergency health risk from the accident location to hospital is shorter than via other means of transport and may turn out beneficial in further treatment,
- There are circumstances (like for instance topography) that could disable or significantly delay the arrival of other medical rescue units in cases of sudden and health-threatening injuries,
- Mass casualty incidents (an emergency in which the need for medical rescue services exceeds the resources of the services called in and there is a necessity to implement segregation in the form of setting medical and transportation priorities),
- An unconscious person,
- Cardiac arrest,
- Bad cardiologic conditions,
- hypertension crisis,
- brain stroke,
- traffic accidents,
- falls from height,
- earth collapses, avalanches,
- multi-organ traumas,
- head traumas requiring immediate neurosurgical intervention,
- spinal trauma with paraplegia, tetraplegia or lateralisation syndromes,
- penetrating neck injury, chest injury, abdominal injury,
- two or more long bones fractured,
- heavy pelvis injuries,
- traumatic limb amputation,
- second or third-degree burns on over 20% of the body surface, the possibility of respiratory tract burns, electric burns, explosions, fires,
- hypothermia,
- drowning,

- other emergency health threats requiring an immediate intervention of a health rescue team.

The Medical Air Rescue Base in Łódź was active since May 17, 2004. As its area, the north-eastern part of the Łódź-Lublinek airport located on the city's southern suburbs was chosen. But until that time the heart of Poland was not covered by medical air service and the closest bases with active medical rescue helicopters were Warsaw (120 km away), Kielce (130 km), Katowice (167 km), Wrocław (187 km), Poznań (192 km) and Bydgoszcz (181 km).

The Polish Medical Air Rescue, by making available a rescue helicopter tries to fill in the gap in the medical rescue system, thanks to which in cases when someone's life and well-being are at risk, they can be reached in the shortest time possible and transported to a proper medical facility.

The helicopter used by the Medical Air Rescue of Łódź is Mi-2 plus. This type of vehicle has been used by the Medical Air Rescue. It was adapted and equipped so as to serve medical rescue purposes well. One recumbent patient can be carried at a time. A stretcher is loaded onto the cargo (medical) compartment via the back door on the left side of the hull. During the flight, a patient lies with his or her legs towards the direction of the flight. The inside of the helicopter makes available the proper access to the patient, especially from the patient's left side and head side. Thanks to that, the patency of the upper respiratory tract can be maintained and haemorrhages can be stopped in the helicopter. However, since on board the space is limited, it is recommended to implement all the appropriate medical procedures aimed at securing the patient before taking off. The medical equipment of a helicopter is a defibrillator (Lifepak 12), a transport ventilator (Medumat Standard A), two oxygen cylinders (5 and 2 litres), syringe driver, electrical aspirator, medical thermal box and a rucksack with equipment and medications and chemicals.

A helicopter should take off within 4 minutes after being called in (i.e. after the place of the accident is located). Nevertheless, in the winter that time is sometimes even doubled. That is because the temperature is below 0ºC and some of the helicopter components required for starting need to fulfil temperature requirements. What is more, if there is a need to fly farther than 60 kilometres away, the preparations for taking off last 15 minutes, which stems from possible necessity to refuel the helicopter and analyse weather conditions. In the case of transport (cargo) flights, the time for preparations is 30 minutes. That time is necessary to analyse the route and weather conditions, make navigational calculations, refuel the tank and mounting additional equipment (such as an incubator).

The Polish Medical Air Rescue helicopter crew is composed of a pilot, a medical rescue worker and a doctor. The medical rescue worker is seated beside the pilot during the flight and helps him navigate, talk over the radio, monitor the flight parameters and the condition of helicopter components, choose a landing location and detect obstacles. Also, if requested by the doctor, a medical rescue worker can remain in the medical compartment during the flight. The flight is inconvenient because of the vibrations and noise generated by the helicopter engines. For that reason, the patient is applied some noise-cancelling headphones or earplugs, which interferes with the communication with the medical team (the team themselves have earphones which allow them to communicate with each other). Another problem is the maintenance of appropriate, constant temperature in the helicopter both in the winter and in the summer.

The condition of landing close to the site of the incident is finding an appropriate area of at least 35 by 35 metres and proper surface. That is often possible in suburban and rural areas. In built-on areas, helicopters can land in parks and playing fields. Also, landing on a road is a possibility but only after the traffic has been stopped there and the surroundings are not disadvantageous. Most frequently, helicopters land no more than 100 metres away from the incident site. In some cases the vehicles of fire brigades, police or bystanders might be used as a support.

After the landing, the medical rescue worker leaves the helicopter in order to secure the landing site from any outsiders. The rotor and tail rotor come to a complete standstill 2 minutes after the landing (4 minutes in the winter). During that time they pose a threat to any people in the vicinity of the vehicle. The task of a medical rescue worker is not to let anybody (including the members of other rescue and emergency services) approach the helicopter. If the circumstances are safe enough, the medical rescue worker escorts the doctor outside the danger zone within that time so that he or she can begin first aid.

While the vast majority of patients can be transported using choppers, there are some for whom certain contraindications exist. This group includes patients with cardiac arrest, who are unlikely to survive the transportation, pregnant women in the second stage of childbirth and the cases of psychomotor agitation. Additionally, the HEMS team can refuse to transport a person and transfer him or her to a ground team, if transporting that person in a helicopter would be medically unjustified.

The Mi-2 plus helicopter's speed is 180 km/h. Depending on the wind direction that speed may increase or decrease.

One of the most important issues related to helicopter emergency medical service is the risk connected with the nature of the flight. There are three groups of subjects whose safety during air operations must be taken into consideration:

a) third persons that are not directly involved in the air operation in question and their property. Their safety is the most crucial.

b) The persons carried in a helicopter, be they the ill and the wounded or medical rescue specialists etc. The safety of these people also requires consideration. Nevertheless, one must assess whether refraining from transportation because of existing risk is not more harmful than the attempt of transportation despite the risk, which is recognized and controlled.

c) The helicopter crew. While it is certainly important to protect them, it may also constitute an element of risk estimation.

There are three phases of danger in air rescue operations:

a) During the flight via the route, if the regulations on minimal height of the flight and horizontal visibility are not observed,

b) At the location of the accident during landing or taking off, if the limits of the vehicle performance or requirements pertaining to the size of the landing zone and the distance from obstacles are not observed, ,

c) At a hospital helipad if the urban sprawl is dense.

The main principle to follow by the HEMS flight squads is that of proportionality between risk and the purpose for which the risk is present [14,15]. For that reason, in many cases when time is not a factor of life and death, it is safer to land at a helipad and carry on with the patient in an ambulance than to land in a public space close to hospital, where the urban sprawl might be quite dense. HEMS flights constitute high-risk operations during which crew, a patient and any persons in the vicinity of the route are in danger [16]. In order to maintain an appropriate level of safety, the helicopter should fly on such a height above the ground that will make the autorotation landing possible should a malfunction or a breakdown occur. The weather conditions should allow the pilot to see any obstacles such as chimneys, antennas or ground electric tractions timely. Therefore during such flights the so-called operating minima should be unconditionally observed. If the minima are not met, the flight must be refused or the helicopter must turn back during the flight. A flight can be carried out only if the cloud base is at least 400 ft above, and the visibility exceeds 3000 m [17,18,19].

III. REFERENCES

[1] Fortier R. Igor Sikorsky: one man, three careers National Aviation Museum 1996. http://www.aviation.technomuses.ca/assets/pdf/e_sikorsky.pdf

[2] http://www.sikorskyarchives.com/first.html

[3] Neel H.Helicopter evacuation in Korea.U.S U. S. Armed Forces M J 1955; 8: 8-12.

[4] Page T N, Neel H.Army aeromedical evacuation U.S Armed Forces M J 1957; 8:8-13.

[5] Dorland P., Nanney J.Dust off: army aeromedical evacuation in Vietnam. Center of military history U S Army. Washington; Govt Pub, Federal, 1982.

[6] http://www.umm.edu/shocktrauma/history.htm

[7] http://www.mspaviation.org/frames.asp

[8] Foundation for Air-Medical Research & Education Air Medicine: Accessing the Future of Health Care. http://www.nasemso.org/projects/airmedical/

[9] http://www1.adac.de/adac-im einsatz/Luftrettung/default.asp?id=3956&location=2_ADAC+im+Einsatz

[10] http://www.drf-luftrettung.de/

[11] http://www.oeamtc.at/flugrettung/

[12] http://www.londonsairambulance.com

[13] Gałązkowski R, Kłosiński P. Polskie lotnictwo sanitarne 1955-2005.Warszawa; Wydawnictwo medyczne Borgis, 2005.

[14] Coats T J, Newton A. Call selection for the Helicopter Emergency Medical Service: implications for ambulance control. JRSM 1994; Vol. 87: 19-24.

[15] Rozporządzenie Ministra Infrastruktury z dnia 5 listopada 2004r. w sprawie eksploatacji statków powietrznych. http://bip.transport.gov.pl/pl/bip/akty_prawne/transport_lotni-czy/rozporzadzenia/rozp_bezp_eksploat_stat_powietrz/px_ust1_2.pdf

[16] Jacobs LM, Bennett BA. critical care helicopter system in trauma. JNMA 2001; 81: 24-29.

[17] Department of Health, Social Services & Public Safety (Belfast) and Department of Health & Children (Dublin) Final Report Feasibility study on a helicopter emergency medical service (HEMS) for the island of Ireland. http://www.dhsspsni.gov.uk/hems_contents.pdf

[18] Instrukcja operacyjna (zbiór procedur operacyjnych) SP ZOZ LPR. http://www.infor.pl/dzienniki-urzedowe/urzedu-lotnictwa-cywilnego,rok,2011,nr,10/poz,45,komunikat-nr-29-prezesa-urzedu-lotnictwa-cywilnego-w-sprawie-zdarzenia.html

[19] http://www.lewebmag.com/article.php3?id_article=126&lang=en